WE CLAIM:

- A solid state nuclear magnetic resonance (NMR) method for investigating a sample material that contains protons H and also spin-1/2 hetero nuclei X, the method comprising the steps of:
 - a) increasing an equilibrium polarization of X;
 - b) suppressing proton magnetization;
 - c) transferring polarization from X to H using a radio frequency (RF) pulse sequence which effects transfer between the nuclei X and spatially proximate protons H utilizing a dipole coupling constant D_{XH}, wherein polarization transfer depends only weakly on couplings of nuclei X to spatially distant protons and only weakly on couplings among the protons themselves;
 - d) recording proton signals under a line narrowing condition,
 wherein the sample material is rotated at a magic angle
 (MAS = magic angle spinning);
 - e) repeating steps a) through d) several times while varying an experimental parameter which is clearly physically associated with a polarization transfer process; and
 - f) determining a dipole coupling constant D_{XH} by analyzing variations in intensity of proton signals recorded in step d).
- 2. A method of claim 1, wherein a ratio between a number of H nuclei to a number of X nuclei is larger than or equal to 10:1.
- 3. The method of claim 2, wherein said ratio is larger than or equal to 100:1.

- 4. The method of claim 1, wherein the X nuclei in the sample have natural abundance.
- 5. The method of claim 1, wherein the X nuclei have a gyromagnetic ratio of $\gamma(X) \le \gamma(^{13}C)$.
- 6. The method of claim 1, wherein the X nuclei comprise ¹⁵N.
- 7. The method of claim 1, wherein the X nuclei comprise ¹³C.
- 8. The method of claim 1, wherein the X nuclei comprise ²⁹Si.
- 9. The method of claim 1, wherein a polarization transfer from H to X is effected in step a).
- The method of claim 1, wherein a cross-polarization is applied in step
 a).
- 11. The method of claim 1, wherein a field gradient pulse is applied in step b).
- 12. The method of claim 1, wherein two radio frequency pulses are applied in step b) having a rotary resonance recoupling condition.
- 13. The method of claim 1, wherein a chemical shift of the X nuclei is encoded between steps b) and c) under proton decoupling in a time interval t₁.
- 14. The method of claim 1, wherein a TEDOR/REPT sequence is applied in step c), with a time interval t_1 ' being an experimental parameter which is clearly physically associated with the transfer process, said

time interval t_1 ' being used between a 90° pulse on X and a 90° pulse on H for encoding the dipole coupling constant D_{XH} .

- 15. The method of claim 13, wherein a TEDOR/REPT sequence is applied in step c), with a time interval t₁' being an experimental parameter which is clearly physically associated with the transfer process, said time interval H being used between a 90° pulse on X and a 90° pulse on H for encoding the dipole coupling constant D_{XH}.
- 16. The method of claim 15, wherein steps a) through d) are carried out several times in succession, wherein t_1 and t_1 ' are simultaneously incremented.
- 17. The method of claim 16, wherein t_1 and t_1 are incremented with different time increments.
- 18. The method of claim 1, wherein a TEODOR/REPT sequence is applied in step c), wherein a time interval t₁' between a 90° pulse on X and a 90° pulse on H is fixed and a number of rotor-synchronized 180° pulses is varied as an experimental parameter which is clearly physically associated with a polarization transfer process, wherein intensities in resulting spectra for different numbers of rotor-synchronized 180° pulses are used to determine dipole coupling constants D_{XH}.
- 19. The method of claim 1, wherein a TEDOR/REPT sequence is applied in step c), and a time interval t₁' between a 90° pulse on X and a 90° pulse on H is fixed and a time difference between rotor-synchronized 180° pulses on X relative to rotor-synchronized 180° pulses on H is varied as an experimental parameter which is clearly physically associated with a polarization transfer process, wherein dipole

coupling constants D_{XH} are determined from spectra extracted for different time differences.

- 20. The method of claim 19, wherein a chemical shift of the X nuclei is encoded between steps b) and c) under proton decoupling in a time interval t₁ and steps a) through d) are carried out several times in succession, wherein both t₁ and a time difference between the rotor-synchronized 180° pulses on X and rotor-synchronized 180° pulses on H are simultaneously incremented.
- 21. The method of claim 20, wherein t_1 and said time difference are incremented with different time increments.
- 22. The method of claim 1, wherein transfer in step c) is effected by a Lee-Goldburg cross-polarization whose time duration is varied as an experimental parameter which is clearly physically associated with a polarization transfer process.
- 23. The method of claim 1, wherein rapid rotation at the magic angle with a rotation frequency which is larger than or equal to 25 kHz (fast MAS) is only effected in step d).
- 24. The method of claim 1, wherein rotation at the magic angle is supported by radio frequency pulses in step d).
- 25. The method of claim 1, wherein rotation at the magic angle is supported by pulsed spin locking in step d).
- 26. The method of claim 1, wherein the method determines X-H binding separations.

- 27. The method of claim 26, wherein said binding separations are of hydrogen bridges.
- 28. The method of claim 1, wherein the method is applied to determine a structure of a peptide chain.